THE RELATIONSHIP OF SKILL RATE TO SUBSEQUENT SKILL ACQUISITION WITH LEARNING DISABLED CHILDREN

BY

SUSAN S. EVANS

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TABLE OF CONTENTS

ACKNOWLEDGMENTS ii

ABSTRACT vi

CHAPTER I

INTRODUCTION 1

Rationale 1
Statement of the Problem 4
Question Under Investigation 4
Related Questions 4
Definition of Terms 5
Limitations 5
Delimitations 6
Summary 6

CHAPTER II

REVIEW OF RELATED LITERATURE 8

What Is Proficiency? 9
The Use of Proficiency in Learning Stages 10
Proficiency in Terms of Subsequent Task Performance . . . 13
Methods to Determine Proficiency 14
Previous Performance 14
Percentage of Improvement 14
Peer Comparison 15
Teacher Suggestion 15
Normative Data 15
Training to Standards 16
Tool Skills 16
Summary 17
Research With Rate and Proficiency 18
Rate Data for Basic Reading Skills 18
Summary 21
Effects of Achieved Criteria on Subsequent Skill Performance. 22
Summary 23

CHAPTER III

METHOD 25

Subjects 25
Setting 27
Materials and Apparatus 27
Stimuli 27
Equipment 28
Procedure 28
Initial Phase 28
Experimental Phase 30
Final Phase 32
Experimental Design 33
Independent Variable 33
Dependent Variable 33
Data Collection and Analysis 33
Recording Procedure 33
Data Analysis 34

CHAPTER IV

RESULTS 35

Initial Phase 36
Experimental Phase 36
Final Phase 40
Analysis of Results 40
Median Comparisons During Final Phase 43
Final Phase Celerations 43
Median Comparisons of Initial and Final Phases 46
Percentage Comparisons of Initial and Final Phases . . . 46
Initial Sound Timing and Uncontrolled Probe Comparisons . 51
Summary 51
Similar Subject Comparisons 55

CHAPTER V

DISCUSSION 58

Interpretation of Findings 58
Median Comparisons During Final Phase 59
Final Phase Celerations 61
Median Comparisons of Initial and Final Phases 61
Percentage Comparisons 62
Initial Sound Timing and Uncontrolled Probe Comparisons . 62
Similar Subject Comparisons 63
Summary 63
Problems and Limitations of the Study 64
Implications and Suggestions for Future Research 66

REFERENCES 68

APPENDIX A PROBE SHEETS 70

B RAW DATA SHEETS AND ACADEMIC BEHAVIOR CHART . . 74

C CELERATIONS ON ACADEMIC BEHAVIOR CHARTS 78

BIOGRAPHICAL SKETCH 87

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By

Susan S. Evans

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A review of the literature suggests that research has not conclusively determined specific optimum proficiency criteria for academic skills. Several researchers suggest that the proficiency level a child attains at a particular skill level may make a critical difference to progress at the next level. This study was conducted to determine if there is a relationship between rate of saying letter sounds (initial skill) and performance on saying CVC (consonant-vowel-consonant) trigrams (subsequent skill) when amount of practice is controlled.

The study involved three phases. During the initial phase, nine learning disabled students in second through fifth grade were matched on saying CVC trigrams. Subjects #1, #2, and #3 were then assigned to the high, medium, and low rate experimental groups, respectively. The study was replicated with the other six subjects. During the

experimental phase, each subject was trained to a different criterion, either a high, medium, or low rate of saying letter sounds (i.e., 80, 60, or 40 sounds per minute). These rates were maintained by using a controlled reader so that the total number of letter sounds said by each subject was the same. During the final phase, each subject was administered 15 one-minute timings on the subsequent skill of saying CVC trigrams.

Growth from the initial to final phase, and growth during the final phase were represented by gain scores, frequency multipliers, and celerations. An examination of the data indicates that the high rate experimental group had the highest total gains in all measures, while results were equally mixed concerning the groups which performed the next highest and lowest on the measures.

This study demonstrates a relationship in similar subject comparisons between a high rate of saying letter sounds and subsequent performance on saying CVC trigrams when amount of practice is controlled. Thus, although all subjects had an equal amount of practice on saying letter sounds, the high rate (80 sounds per minute) of saying letter sounds was better in terms of performance on the subsequent task of saying CVC trigrams. Future research may focus on refinement of the critical aims for specific skills.

CHAPTER I

INTRODUCTION

Chapter I provides a framework for the research study. The sections of this chapter are (a) rationale, (b) statement of the problem, (c) specific questions under investigation, (d) definition of terms, (e) limitations, (f) delimitations, and (g) summary.

Rationale

Making instructional decisions is part of everyday teaching and one of the most important decisions involves determining when students have learned a skill well enough to progress to the next skill. In the past, some teachers used a time criterion. For example, when working on math facts, the student might spend one week reviewing the one-times table, and the following week might be spent reviewing the two-times table. Haughton (1972) reported that when skill acquisition followed the calendar, or a time criterion, individual differences were ignored, and drops in overall performance occurred. Some basic teaching methods seem to be effective for most children, but at different times, levels, and rates (Eaton, 1978).

Different guidelines are available to teachers to help determine when to advance children. However, there is little specific research or agreement as to which guideline to use. Suggestions include the use of norms, peer performance, aims from the child's previous performance on similar skills, and other teachers' recommendations (Eaton, 1978; Haring & Gentry, 1976). Because criteria levels for proficient performance have not been empirically established, deciding when a child has acquired a skill remains a matter of some judgment (White & Haring, 1980).

Specification of precise personalized aims for children began to emerge in classrooms in 1969 (Haughton, 1972). An aim includes a definition of pupil response, conditions under which that response should occur, and criteria for acceptable performance (Haring & Bateman, 1977). A well-specified aim, including how soon that aim will be reached, often makes a major contribution in evaluating a child or program (Lovitt, 1977; Mager, 1962). Underteaching and overteaching are both the result of not specifying what behavior should be taught and to what extent (Lovitt, 1977).

Recently, criteria for advancement have been set in terms of rate correct and incorrect. Rate (frequency) reflects movements and time, which are two dimensions common to all observable behavior (Martin, Koorland, & Pennypacker, 1973). For example, with rate criteria, a child may be required to meet a standard which expresses how accurate he should be in a given period of time (number of correct words said per minute).

For many academic and social skills, rate yields more information than untimed units of measurement (Eaton, 1978; White & Haring, 1980). Rate measures both fluency and accuracy. Fluency is crucial because it is the discriminating factor between a child who has acquired a skill and one who is proficient. Rate is also used to compare different tasks when performance is converted to rate per minute. In addition, it is considered a good indicator of a child's ability to maintain, generalize, and apply a skill outside the classroom.

Many researchers state that proficiency is an important aspect of rate in that competence, application, and future learning are dependent upon it (Haring & Eaton, 1978; Lovitt, 1977; White & Haring, 1980). Ideally, aims should represent proficiency. However, making the decision about appropriate frequency aims or proficiencies for students is not easy for teachers. Some disagreement exists about what constitutes proficiency (Haring & Gentry, 1976). For example, the desired rates for oral reading of words in context range from 100 to 200 or more words per minute (Mercer, Mercer, & Evans, 1981). Moreover, little specific research exists to serve as a guide in setting levels of proficiency (White & Haring, 1980). Some studies offer specific guidelines, but there does not appear to be a concensus among researchers, and the data are not published in a formal manner.

Certain frequencies have been found to be important in learning specific skills and subsequent learning of a related skill. Haughton

(1972) emphasizes that the performance level of a particular skill makes a critical difference on progress at the next level. Therefore, specifying relatively high aims appears to be crucial to student competence and independence. However, a need exists for controlled research to determine what the optimum aims are for specific skills.

Statement of the Problem

Research is needed to analyze the effects of rate of a particular skill on the acquisition of subsequent related skills (Lovitt, 1975; VanHouten, 1979). This investigation focused on examining the relationship of training to different frequencies on subsequent performance of a more complex skill.

Question Under Investigation

Is there a relationship between rate of saying letter sounds and subsequent performance on saying CVC (consonant-vowel-consonant) trigrams when amount of practice is controlled?

Related Questions

1. Is there a relationship between a high rate of saying letter sounds and subsequent performance of saying CVC trigrams when amount of practice is controlled?

2. Is there a relationship between a medium rate of saying letter sounds and subsequent performance of saying CVC trigrams when amount of practice is controlled?

3. Is there a relationship between a low rate of saying letter sounds and subsequent performance of saying CVC trigrams when amount of practice is controlled?

Definition of Terms

Aims—Aims are statements of performance criteria which indicate a desired frequency or rate of performance (Haring & Gentry, 1976).

Proficiency—Proficiency indicates a level of competency which allows the behaver to be independent in terms of the skill concerned. It also permits the learner to use the skill in building more complex skills without limiting the progress of learning (Starlin, 1972).

Rate—Rate is the frequency with which a movement occurs during some standard unit of time (White & Haring, 1980).

Subsequent Performance—Subsequent performance is the adjacent skill, related skill, or more complex skill in an academic scope and sequence.

Limitations

The limitations of the study were as follows:

1. The amount of control over events outside the school setting was limited. Events such as tutoring or reading at home may have affected the study.

2. The selection of Alachua County students may have restricted generality to the geographic area of Alachua County, Florida.

3. The use of nine learning disabled students in grades two through five may not have guaranteed generality to all learning disabled students in grades two through five.

Delimitations

This study was delimited to the following:

1. The subjects included nine learning disabled students in grades two through five.

2. The subjects were identified as learning disabled according to the regulations of the Florida State Department of Education.

3. The subjects attended public elementary schools in Alachua County, Florida.

Summary

Teachers must often decide when students have learned a skill well enough to progress to the next skill. The specification of aims contributes to better evaluation of a child's progress. Aims may be expressed in terms of rate, and ideally should represent proficiency. Establishing when a child has reached proficiency on a skill remains a matter of teacher judgment. However, the level of

performance on a skill is throught to make a difference on progress at the next level. The problem was to determine the effects of different rates of saying letter sounds on subsequent performance of saying CVC trigrams when the amount of practice is controlled.

CHAPTER II

REVIEW OF RELATED LITERATURE

Teaching involves making daily instructional decisions. One such decision includes when to advance children from one skill to the next skill. Educational efficiency must be considered so that no more time than necessary is spent teaching a particular skill (Lovitt, 1977; Starlin, 1971). It is important to establish when a child has mastered a skill so as not to accelerate beyond the proficiency level. However, underteaching should also be avoided. Lovitt (1977) suggests that underteaching and overteaching are both the result of not specifying the behavior to be taught and the extent to which it should be taught.

The specification of behaviors involves aims or objectives. Haughton (1972) stresses that determining the proper aim which indicates competency is of crucial importance. When aims are established precisely and clearly, and then achieved, goals are accomplished.

Aims should be personalized to fit the individual student, but specifying high performance aims is crucial to competence and independence. However, the teacher must be aware of going too far beyond an aim (Haughton, 1972). This may cause more errors, instead

of strengthening correct performance. Asking too much of a student may result in frustration rather than success.

Specific aims of skill attainment should be translated into measurable responses. Rate is chosen as the unit of measurement in much current research (Eaton, 1978). Aims are then stated in terms of rate and proficiency. Making decisions concerning skill proficiencies can, however, be difficult. Disagreement exists concerning what constitutes proficiency.

Four areas of literature will be reviewed in this chapter. First, proficiency will be discussed in terms of learning stages and in terms of subsequent task performance. Second, several methods used to determine proficiency will be reviewed. An analysis of the data using rate to determine proficiency is the third area of discussion. Finally, the effects of achieved criteria on subsequent skill performance will be analyzed.

What Is Proficiency?

Proficiency is an important aspect of rate in that competence in a skill, application of acquired skills, and future learning are dependent upon it (Haring & Eaton, 1978; Lovitt, 1977; White & Haring, 1980). There are many opinions on the definition of proficiency. White and Haring (1980) define it as "the performance of a movement or series of movements in relation to a preset criterion" (p. 321). Other words used to describe proficiency are "automatic" (Haughton, 1972) and "fluent" (Starlin, 1972). Haring and Gentry

(1976) define proficiency in terms of desired frequencies or rates of performance, and Koenig and Kunzelmann (1977) define proficiency as a correct performance speed, not fast or slow, but consistent and comfortable among successful performers.

Proficiency is also discussed in terms of mastery. Alper, Nowlin, Lemoine, Perine, and Bettencourt (1974) state that a student has attained mastery when he has both the knowledge of how to perform a response and a specific skill level in responding. Starlin (1971) speaks of proficiency in terms of the minimum fluency, consistency, speed, and accuracy levels necessary to demonstrate mastery of the material.

The Use of Proficiency in Learning Stages

Proficiency is sometimes a step in a learning stage or hierarchy. Several authors have described stages of learning ranging from initial exposure to proficient or expert performance of a skill (see Table 1). Various authors have used different terms to describe the stages.

White and Haring's stages of skill development. White and Haring (1980) speak of skills developing through the following stages: acquisition, fluency building, maintenance, application, and adaptation. The fluency building stage ends when intermediate or terminal proficiency aims are reached. White and Haring define intermediate proficiency as "the performance characteristics that a child must demonstrate before he can be considered to have mastered an intermediate objective. Intermediate proficiencies should be empirically determined so that achieving them will insure that a child will

Table 1

The Use of Proficiency in Learning Stages

White & Haring (1980)	Haring & Eaton (1978)	Lovitt (1977)
Acquisition: learning the basic movements of a task; a matter of judgment.	Acquisition: the period between first performance and accurate performance of a behavior; 0-90/100%.	Initial acquisition: exposure to a new skill not in repertoire; instruction needed.
Fluency building: performing the skill quickly and easily; making the skill truly useful; intermediate and terminal proficiencies at this level.	Proficiency or fluency building: performance of a skill at a level to insure maintenance and success in later or related skills, and at a level comparable to others or peers.	Advanced acquisition: mastery of half of the skill fundamentals.
Maintenance: retention of the skill and level of fluency.	Generalization: performance of the skill in response to new stimuli; as in another setting.	Initial proficiency: knowledge of all rules and principles pertaining to a skill, but not fluent or automatic; practice helps to increase rate.
Application: using the skill in situations outside of the classroom.	Adaptation: skill is usable in modified form in response to new problems or situations without need for direction.	Proficiency: maintenance of the skill; adept at performing the behavior.
Adaptation: applying the skill in other situations with modifications that might be required.		Note: the closer to proficiency, the more practice and less instruction needed.

maintain or improve his performance when he moves on to work on the next objective in the sequence" (p. 314). Terminal proficiency refers to those "characteristics of a performance which are necessary for success when a person moves from one situation to another" (White & Haring, 1980, p. 328).

Haring and Eaton's learning hierarchy. The learning hierarchy discussed by Haring and Eaton (1978) is similar to White and Haring's stages of skill development. Acquisition is the first step in learning a skill. This lasts until a reasonably accurate performance of that behavior is displayed, usually between 90 and 100 percent accuracy. Proficiency or fluency building is the next step. This stage lasts until the student can perform the skill at the desired correct and error rates. Generalization, the third stage, involves performing the skill in another setting, and adaptation, the fourth stage, refers to application without the need for directions.

Haring and Eaton (1978) suggest three definitions of the proficiency or fluency stage. The first involves the insurance of maintenance of that skill. The second definition refers to success in later or related tasks and skills. The third definition refers to the performance of a skill at some level comparable to that of others and/or peers. Haring and Eaton conclude that "the specific skill related definition of each proficiency level will probably be determined through empirical research and a diagnosis of individual learner needs" (p. 27).

Lovitt's stages of development. Lovitt (1977) also refers to four stages of development: initial acquisition, advanced acquisition, initial proficiency, and proficiency. During the proficiency level, the pupil is adept at performing the behavior automatically, without a great deal of thinking beforehand.

Summary. Proficiency is a step in each learning stage. Definitions of proficiency include these aspects: (a) characteristics necessary for success in subsequent, related tasks; (b) a level to insure maintenance of that skill; (c) performance at a level comparable to that of others and/or peers; and (d) performing the behavior automatically without a great deal of thinking beforehand.

Proficiency in Terms of Subsequent Task Performance

As mentioned in the previous section on learning stages, one way of defining proficiency is in terms of performance on later and/or related tasks. Koenig and Kunzelmann (1977) report that proficient performance allows one to function in new situations which require problem solving. Proficiency indicates a level of competency which allows independence and ability to use the skill to build more complex skills (Starlin, 1972). White and Haring (1980) define terminal proficiency as the ability to move from one situation to another, particularly to situations outside of the classroom. Lovitt (1977) refers to later/related tasks in terms of generalization. Generalization, the process by which students learn to apply classroom skills to real life situations, is "to a great extent what education is all about" (Lovitt, 1977, p. 154).

Methods to Determine Proficiency

There are no standard criteria to define a certain performance that must be demonstrated before advancement to the next level of difficulty. Little specific research exists to serve as a guide in setting levels of proficiency (White & Haring, 1980). Presently, establishing when a child has acquired a skill is a matter of judgment. Though research has not conclusively determined specific aims for academic tasks (Mercer, 1979), several authors offer general guidelines.

Previous Performance

Eaton (1978) uses previous performance as a method for setting aims. Using a student's learning rate on a previous task may help to establish a performance criteria on a new but similar task. For example, rate of saying addition facts may be similar to rate of saying subtraction facts, and therefore may be used to set a criterion.

Percentage of Improvement

Lovitt and Hansen (1976) suggest using a percentage of improvement. First, each pupil is placed into a reader based on three performance scores: correct oral reading rate between 45 and 65 words per minute, incorrect oral reading rate between 4 and 8 words per minute, and average comprehension score between 50 and 75 percent. The authors' intent was to place children in the highest reader possible, where they would be motivated but not frustrated. When the child improved 25 percent over the baseline rate of oral reading

and answered comprehension questions with 90 percent accuracy, he attained mastery and was able to progress to the next reading level.

Peer Comparison

Several authors suggest peer comparison to set proficiencies (Eaton, 1978; Haring & Bateman, 1977; Haring & Gentry, 1976). Lovitt (1977) suggests that teachers can refer to data on similar children or peers who are performing acceptably. Eaton (1978) states that if peers are performing comparably in learning patterns, rates, and performance levels, it is reasonable to expect similar aims.

Teacher Suggestion

Other teachers may also be helpful in specifying aims that children should reach in specific materials and grade levels (Haring & Gentry, 1976; Lovitt, 1977). A teacher whom a child has had in the past may be able to give a realistic idea of aims for specific academic tasks based on a child's past performance.

Normative Data

It has also been suggested to use normative data as a guideline. Eaton (1978) recommends collecting individual data for a large number of children on the same skill and using the central tendency to set an aim.

Training to Standards

VanHouten (1979) recommends examining the effects of training to various standards on the subsequent acquisition of more complex skills. Standards of competent individuals may be used rather than normative data. If norms are used, they may be below competence, according to VanHouten.

Tool Skills

Koenig and Kunzelmann (1977) state that proficiency rates for many skills are not known. They suggest, however, that the chance for success in learning can be increased by high rates of performance in some prerequisite skills. Those skills are sometimes called tool skills, or those prerequisite performances which allow the basic skills to be attained easier. Examples of tool skills are saying letter sounds or writing digits. Haughton (1972) states that if children can do tool movements at acceptable frequencies, they can meet most curriculum demands.

There is very little information concerning what fluency is for basic tool movements (White & Haring, 1980). In general, the tool movement frequency should be raised to a point well above the criteria set for more advanced objectives in which those tool movements will be used. White and Haring suggest that the tool movement rate be 1.5 to 2.0 times the goal for the next step.

An adult to child proportional formula has also been proposed to deal with establishing proficiencies (Eaton, 1978). The formula is expressed as: $\frac{\text{child's rate}}{\text{child's tool skill rate}} = \frac{\text{adult's rate}}{\text{adult's tool skill rate}}$.

For example, an adult may write digits (the tool movement) at a rate of 150 digits per minute and may write answers to addition facts at a rate of 100 digits per minute. A child may write digits at a rate of 60 digits per minute. An analysis of the formula indicates that a child could be expected to write answers to addition facts at a rate of 40 digits per minute.

Summary

Concensus is lacking concerning what the standard criteria should be to define a proficient performance, and few specific guidelines exist to set levels of proficiency. However, several methods were presented to determine proficiency:

1. Using a student's previous performance rate may be helpful in setting a rate for a new, but similar task (Eaton, 1978).

2. Lovitt and Hansen (1976) suggest using a percentage of improvement over baseline to determine advancement to the next reading level.

3. Teachers can refer to data on similar children or peers who are performing acceptably (Lovitt, 1977).

4. Other teachers whom a child has had in the past may offer suggestions for appropriate aims (Haring & Gentry, 1976; Lovitt, 1977).

5. Eaton (1978) recommends the use of normative data to set proficiencies.

6. VanHouten (1979) suggests examining the effects of different skill rates on subsequent acquisition of related skills.

7. Koenig and Kunzelmann (1977) suggest that success in learning may be increased by high rates of performance in prerequisite tool skills.

Research With Rate and Proficiency

Although there are several methods to determine proficiency, rate yields more information than other units of measurement for many academic and social skills (Eaton, 1978; White & Haring, 1980). Perhaps the most important advantage of the use of rate is the aspect of fluency. Rate measures both fluency and accuracy, but fluency is the crucial factor because it can be used to discriminate between a child who has acquired a skill and one who is proficient. Though standard rate criteria are lacking concerning proficiencies in basic skills, data have been collected by various researchers.

Rate Data for Basic Reading Skills

Mercer (1979) reviewed rates of performance on academic tasks collected by several researchers and found a range of suggested proficiencies for the same academic tasks (see Table 2). Starlin (1971), in reviewing progress charts of students, informally recommends proficiency criteria for some basic reading skills. Letter sounds should be said aloud at a frequency of 40 sounds per minute with two or less errors, while sight words should be read aloud at a frequency of 50 words per minute with two or less errors. A suggested rate of oral reading is 100 to 120 words per minute with two or less errors.

Table 2

Rates for Basic Reading Skills

	Say isolated sounds Correct/Error	Say words in list Correct/Error	Say words in text Correct/Error
Alper, Nowlin, Lemoine, Perine, & Bettencourt (1974)	80/2	60-80/2	100-120/3
Haring & Gentry (1976)	61/4	58/7	
Haughton (1972)	100/0		
Precision Teaching Project	60-80/0	80-100/0	200+/0
Regional Resource Center	60-80/2	80-100/2	100/2
SIMS Reading and Spelling Program		50/2	100/2
Starlin (1971)	40/2	50+/2	100-200/2
Wolking (1973)	44/0	104/0	120-132/0
Range:	40-100/0-4	50-100/0-7	100-200/0-3
Mode:	80/2	80/2	100/2
Median:	60-80/2	60-80/2	100-200/2

Wolking (1973) collected rates on high achievers in Grade 3. He found that letter sounds were said at a rate of 44 per minute, words in a list read at 104 words per minute, and words in a text read at a rate of 120-132 words per minute.

Haughton (1972) simplifies the process of identifying specific rates for each different skill. He suggests that aims between 100 and 200 movements per minute are crucial in indicating proficient performance no matter what the curriculum area. Haughton recommends saying isolated sounds at a rate of 100 sounds per minute.

Alper, Nowlin, Lemoine, Perine, and Bettencourt (1974) suggest aims for basic reading skills. The aim for saying consonant sounds and vowel sounds is 80 correct per minute with one or two errors. The aim for saying three, four, and five-letter regular words and sight words is 60 to 80 words per minute with less than two errors. Words in context should be read orally at 100 to 120 words per minute with less than two errors.

Haring and Gentry (1976) recommend aims for saying isolated sounds and words in a list. Isolated sounds should be said at a rate of 61 sounds per minute with four errors or less. Words in a list should be said at a rate of 58 words per minute and with seven errors or less.

Much data presently available are from several precision teaching projects such as the Precision Teaching Project from Great Falls, Montana, the Regional Resource Center Diagnostic Inventories from the University of Oregon, SIMS Reading and Spelling Program from Minneapolis,

and a project by Koenig and Kunzelmann (1977) from Kansas City, Missouri (Mercer, Mercer, & Evans, 1981; see references for addresses). Rates from these projects are based on extensive sampling of student performance. Suggested rates for basic reading skills are as follows.

The Precision Teaching Project recommends aims for saying isolated sounds at 60 to 80 sounds per minute, saying sight words at 80 to 100 per minute, and saying words in text at 200 or more words per minute. The Regional Resource Center suggests saying isolated sounds at 60 to 80 per minute with two or less errors, saying words in a list at 80 to 100 per minute, and saying words in a text at 100 words per minute. The SIMS Program recommends saying words in a list at 50 words per minute and in a text at 100 words per minute, both with two or less errors.

Summary

Based on rate data collected by several researchers, the aim for saying lowercase and uppercase letters and isolated sounds appears to be 80 movements correct per minute. The aim for saying words in a list is 80 words per minute or above, and reading texted words is 100 words per minute or above. Though data are accumulating, research has not conclusively determined specific proficiency aims for academic skills.

Effects of Achieved Criteria on Subsequent Skill Performance

The proficiency level a child attains at a particular skill level makes a critical difference to progress at the next level (Haughton, 1972). The problem is to determine which frequency criterion is best relative to a student's progress at the next level. Haughton observed that low criteria do not assist children in increased performance at the next level. For example, children who are slow single-letter writers will also be slow word writers. Children who add single digits at a slow rate will also add two-digit numbers at a slow rate. However, a relatively high say-sounds rate usually increases the acquisition of an effective oral reading frequency. Correlation of say sounds to say words is as high as .6 to 1.0.

Haughton (1972) also reports that at a frequency of less than 50 words read orally per minute, emphasis on correcting errors produced little gain in performance. Errors failed to decelerate, and correct performance failed to accelerate. However, if correct words were accelerated to at least 50 words per minute read orally before working on reducing errors, the children showed much improvement in rate correct and incorrect. There seems to be an important relationship between certain frequencies and that skill's growth, and to growth in a related skill.

Gaasholt (1970) collected data on children performing basic multiplication facts. One student performing below 20 digits per minute in math facts decelerated as he progressed to more difficult facts. A second student performing above 30 digits per minute in

math computations easily advanced to progressively more complex math assignments. Gaasholt concluded that the second student probably reached his proficiency level on the first set of facts since his rates on more difficult problems were satisfactory.

To determine the optimum proficiency level of a particular skill, effects of training to various standards on the subsequent acquisition of more complex skills need to be examined (VanHouten, 1979). Establishing optimum proficiencies would be a tool in aiding educational efficiency.

Summary

Daily instructional decisions should be based on specific skill aims. Aims are then stated in terms of rate and proficiency. Proficiency is an important aspect of rate in that competence, application of acquired skills, and future learning may be dependent upon the rate at which a task is completed. However, the definition of proficiency varies. Proficiency is described in terms of learning hierarchies, and later and/or related tasks. Guidelines are suggested but little specific research exists to serve as a guide in establishing levels of proficiency (White & Haring, 1980). Data are available from precision teaching projects in particular, concerning specific criteria to determine proficiency. These data are based on extensive sampling of student performance. Research has not, however, conclusively determined specific optimum proficiency aims for academic skills.

Haughton (1972) states that the proficiency level a child attains at a particular skill level does make a critical difference to progress at the next level. VanHouten (1979) suggests analyzing the effects of training to various standards on the subsequent acquisition of more complex skills. It is necessary to determine which frequency criterion is best for each academic task related to progress at the next level.

CHAPTER III

METHOD

Level of skill proficiency is thought to be related to progress at the next skill level. The problem in this investigation was to determine the effects of different rates of saying letter sounds on subsequent performance on saying CVC trigrams when the amount of practice is controlled.

In Chapter III, the method and procedures of the study are presented. Included is a description of the subjects, setting, materials and apparatus, procedure, experimental design, independent and dependent variables, and method of data collection and analysis.

Subjects

The subjects in this investigation were nine students from second through fifth grade (demographic data are presented in Table 3). All of the subjects met the criteria for the Florida definition of "learning disabled" and were labelled learning disabled by Alachua County Public Schools. In order to qualify for the study, the subjects recognized at least 10 consonant sounds and said CVC trigrams at a rate of 60 or less per minute. The subjects were equated

on the task of saying CVC trigrams. There was a range of no greater than 10 words correct per minute of saying CVC trigrams between the nine subjects.

Table 3

Demographic Data

Subject	Age	Grade	Sex	Race	CVC Trigram Timings 1 (correct/incorrect)	2 (correct/incorrect)	median (correct)
#1	10	4	male	black	26/ 2	36/7	31
#2	9	2	male	black	21/11	20/9	21
#3	8	3	male	white	26/ 9	29/8	28
#4	11	4	female	black	31/ 7	30/6	31
#5	10	4	female	black	23/ 7	20/7	22
#6	11	5	male	black	27/ 2	26/2	27
#7	10	4	male	black	23/ 2	23/3	23
#8	12	5	female	black	23/ 7	26/7	25
#9	12	5	female	black	29/10	29/8	29

Setting

The subjects all attended a part-time class for the learning disabled in a public school in Alachua County. The pupil/teacher ratio in each class ranged from five to eight students per teacher. Instructional sessions were conducted in a quiet section of the classroom.

The experimenter was seated to the right side of the subject. The stimulus materials were placed directly in front of the subject. During the maintenance portion of the experimental phase, a controlled reader was in front of each subject.

Materials and Apparatus

Stimuli

Two probe sheets were used in this study. The first sheet included 19 consonants and the "a" vowel. There were two forms of this probe sheet—probe sheet #1 and alternate probe sheet #1. Alternate probe sheet #1 was used to decrease the possibility of memorizing the letter sequence. These probe sheets each included 80 letters, 10 in each line. Because the vowel "a" was used more often in the CVC trigrams than the consonants, it was included more often than the consonants. An example is provided in Appendix A. The second probe sheet included CVC trigrams. There were 100 words on this sheet, 10 words in each line. An example is displayed in Appendix A. Raw data sheets were used to record each response on both probes. An example is provided in Appendix B.

Equipment

The experimenter used a stopwatch for each one-minute timing. An EDL controlled reader was used to control the rate of letters seen and said by the subjects during the maintenance portion of the experimental phase. The same letters used in probe sheet #1 were on a controlled reader filmstrip designed for this study.

Procedure

Initial Phase

An untimed pretest was administered to each subject on the entire probe sheet including the CVC trigrams (probe sheet #2). Percentage correct and incorrect were recorded. An example of the experimental design is presented in Figure 1.

Each subject was also administered two one-minute timings on probe sheet #2 during the first experimental period. The subjects were presented with the probe sheet and instructed to say the words as quickly as possible after being told to "begin." Rate correct and incorrect were recorded. The mean scores of these two timings were used to match the subjects. There was a range of no greater than 10 words correct per minute of saying CVC trigrams between the nine subjects.

In addition, each subject was administered a one-minute timing on the sound probe sheet (probe sheet #1). The subjects were presented with the probe sheet and instructed to say the sounds as quickly as possible after being told to "begin." Rate correct and incorrect were

	Initial Phase	Experimental Phase	Final Phase
Subjects #1,#4,#7	CVC trigrams: one untimed trial two one-minute timings. Letter sounds: one one-minute timing.	Letter sounds: three one-minute timings completed daily. High rate maintained with controlled reader until 940 sounds are said. 80 sounds per minute	Letter sounds: one uncontrolled probe timing. CVC trigrams: 15 one-minute timings (3 daily) 1 untimed trial.
Subjects #2,#5,#8	CVC trigrams: one untimed trial two one-minute timings. Letter sounds: one one-minute timing.	Letter sounds: three one-minute timings completed daily. Medium rate maintained with controlled reader. 60	Letter sounds: one uncontrolled probe timing. CVC trigrams: 15 one-minute timings (3 daily) 1 untimed trial.
Subjects #3,#6,#9	CVC trigrams: one untimed trial two one-minute timings. Letter sounds: one one-minute timing.	Letter sounds: three one-minute timings completed daily. Low rate maintained with controlled reader. 40	Letter sounds: one uncontrolled probe timing. CVC trigrams: 15 one-minute timings (3 daily) 1 untimed trial.

Figure 1

Experimental Design

recorded. Each subject said at least 10 correct consonant sounds. The same experimenter presented all timings to each subject. Responses were immediately recorded on raw data sheets following each timing.

Thus, during the initial phase, each subject was administered the following: (a) one untimed trial of saying CVC trigrams—probe sheet #2; (b) two one-minute timings on probe sheet #2; and (c) one one-minute timing on saying letter sounds—probe sheet #1. The data from the two timings on saying CVC trigrams were used in matching subjects.

With one exception, students were randomly assigned into the high, medium, and low experimental phases. Subject #1 was assigned to the high rate experimental phase due to his initial high rate of saying sounds.

Experimental Phase

Subjects assigned to the high rate experimental group attained the goal of saying letter sounds at 80 per minute, and maintained this rate by using a controlled reader for at least eight timings. Subjects assigned to the medium rate experimental group attained the goal of saying letter sounds at 60 per minute, while subjects in the low rate experimental group attained the goal of saying letter sounds at 40 per minute, both groups maintaining their respective rates with a controlled reader. Subjects #1, #2, and #3 were assigned to the high, medium, and low rate experimental groups respectively. The experimental study was then replicated twice with six more subjects.

Subjects #4 and #7 were in the high rate experimental group, Subjects #5 and #8 were in the medium rate experimental group, and Subjects #6 and #9 were in the low rate experimental group.

All subjects were presented with the first probe sheet which included all consonant and vowel "a" letters. One-minute timings were given on this task of saying letter sounds. The subjects were told to say the sounds of each letter as quickly as possible across each line after being told to "begin." Probe sheet #1 and alternate probe sheet #1 were alternated at each timing. Three one-minute timings were presented during each daily experimental period, and praise feedback was given upon completion of each timing irrespective of performance. Responses were immediately recorded on raw data sheets. After the subjects completed each timing, they were given informational feedback on the incorrect letter sounds. This consisted of the experimenter informing the subject of the incorrect response, and in turn, the appropriate, correct response.

Subjects #1, #4, and #7, assigned to the high rate experimental group, were presented one-minute timings (three daily) until a goal of 80 sounds said with five or less errors was attained. This rate was held constant by using the controlled reader. Subject #1 was the first to reach this goal. His rate was maintained for eight timings. The total number of letter sounds said by Subject #1 during the experimental phase was determined and used to keep the amount of sounds said constant with subjects in all other experimental groups. As a result, the number of letter sounds completed by Subject #1 established the amount of practice all subjects would have during the experimental phase.

Subjects #2, #5, and #8, assigned to the medium rate experimental group, were presented one-minute timings (three daily) until a goal of 60 sounds said with five or less errors was attained. This rate was held constant by using the controlled reader until the total number of sounds said was equivalent to sounds said by Subject #1.

Subjects #3, #6, and #9, in the low rate experimental group, were presented one-minute timings (three daily) until a goal of 40 sounds said with five or less errors was attained. This rate was held constant by using the controlled reader until the total amount of sounds said was equivalent to sounds said by all other subjects in all experimental groups.

Final Phase

Upon completion of the experimental phase, an uncontrolled probe timing of saying sounds was administered. This determined whether the child's actual rate was consistent with the rate held constant by the controlled reader.

The second probe sheet consisting of CVC trigrams was administered again to each subject. An untimed posttest was given on the CVC probe sheet. Percentage correct and incorrect were recorded.

Fifteen more one-minute timings of saying CVC trigrams were completed with each subject during the final five experimental periods. The subjects were instructed to say the words as quickly as possible after being told to "begin." Rate correct and incorrect were recorded.

Experimental Design

The design of this study was a single subject design with two replications. Each subject trained to a different criterion. This design allowed for an analysis of the effect of rate and amount of trials on each individual's subsequent skill performance.

Independent Variable

There was one independent variable in this study. Rate of saying letter sounds was manipulated and then held constant with each subject.

Dependent Variable

Correct and incorrect words per minute and percentage of words correct on the subsequent skill of saying CVC trigrams represent the dependent variable in this study. These scores were determined during the final phase which included one untimed trial and 15 one-minute timings.

Data Collection and Analysis

Recording Procedure

After each timing, the experimenter recorded correct and incorrect responses on the raw data sheets. Data for the experimental phase and the final phase were plotted daily on an academic behavior chart (Berquam, 1979). An example is provided in Appendix B.

Data Analysis

To determine whether a relationship exists between rate of saying letter sounds and subsequent performance on saying CVC trigrams, several methods of analysis were completed. The median of the first three CVC word timings of the final phase, the median of the last three CVC word timings of the final phase, and the celeration of all of the timings of this final phase were determined for each subject. The median of the two CVC timings during the initial phase and the median of the last three CVC timings during the final phase were compared. Percentage correct and incorrect of saying CVC trigrams during the initial and final phases were compared. A comparison of the first sound timing in the initial phase and the uncontrolled probe timing during the final phase was also done.

Gain scores and celerations were used to analyze the data. Gain scores represented growth from one median score to another median score. Celerations were determined by the quarter-intersect method which yields a high degree of accuracy (Pennypacker, Koenig, & Lindsley, 1972). The time span covered by frequency dots is first divided into four equal quarters. The median frequency of each half of the frequency dots is then found. A dash is placed on the quarter line corresponding to the median frequency, and then a straight line connecting the points where the dashes cross the first and third quarter lines is drawn. This is the celeration line.

CHAPTER IV

RESULTS

The primary purpose of this study was to determine if there is a relationship between rate of saying letter sounds and subsequent performance on saying CVC trigrams when amount of practice is controlled. The data were collected in daily individual sessions with each of nine subjects according to the following schedule:

Initial Phase

A. CVC trigrams (Probe sheet #2)

   1. one untimed trial

   2. two one-minute timings

B. Letter sounds (Probe sheet #1)

   1. one one-minute timing

Experimental Phase

A. Letter sounds—three one-minute timings completed daily until 940 sounds are said by each subject

   1. high rate experimental group—maintained at 80 sounds/minute

   2. medium rate experimental group—maintained at 60 sounds/minute

   3. low rate experimental group—maintained at 40 sounds/minute

Final Phase

A. Letter sounds—one uncontrolled probe timing

B. CVC trigrams

1. one untimed trial

2. 15 one-minute timings (3 completed daily)

Initial Phase

An untimed pretest and two one-minute timings of saying CVC trigrams were administered to each subject. Data including percentage correct, rate correct and incorrect on the timings and the median rate correct and incorrect are displayed in Table 4. The nine subjects were matched on rate of saying CVC trigrams. The median rate correct ranged from 21 words per minute for Subject #2 to 31 words per minute for Subjects #1 and #4.

Each subject was also administered a one-minute timing on saying letter sounds (Probe sheet #1). Data including rate correct and incorrect are displayed in Table 4.

Experimental Phase

During this phase, each subject completed one-minute timings on saying letter sounds. Subject #1 was presented one-minute timings until a goal of saying 80 sounds with five or less errors was attained for two days in a row. This rate was maintained by using the controlled reader for eight timings. The total number of letter sounds said by

Table 4

Initial Phase Data

Group and Subject	CVC-% (Correct)	CVC Timings 1 (Correct/Incorrect) per minute	CVC Timings 2 (Correct/Incorrect) per minute	Median of CVC Timings (Correct) per minute	Sound Timing (Correct/Incorrect) per minute
Group 80					
Subject #1	81	26/2	36/7	31	64/0
Subject #4	88	31/7	30/6	31	37/8
Subject #7	91	23/2	23/3	23	48/5
Group 60					
Subject #2	80	21/11	20/9	21	36/1
Subject #5	75	23/7	20/7	22	22/8
Subject #8	79	23/7	26/7	25	58/8
Group 40					
Subject #3	86	26/9	29/8	28	31/8
Subject #6	91	27/2	26/2	27	36/5
Subject #9	79	29/10	29/8	29	23/2

Subject #1 during the experimental phase of 11 one-minute timings was 940. This total number of letter sounds was used for all subjects to keep the amount of practice on saying letter sounds equivalent across subjects.

Subject #2 was presented one-minute timings until a goal of saying 60 sounds with five or less errors was attained. This rate was held constant by using the controlled reader until 940 sounds were said, accomplished in 16 timings.

Subject #3 was presented one-minute timings until a goal of saying 40 sounds with five or less errors was attained. This rate was held constant by using the controlled reader until 940 sounds were said, accomplished in 24 timings.

The experimental phase was replicated with six more subjects. Subjects #4 and #7 were in the high rate experimental group (maintained at 80 sounds per minute). They completed the 940 sounds in 12 timings. Subject #5, in the medium rate experimental group (maintained at 60 sounds per minute) completed the total number of sounds in 17 timings, while Subject #8, also in the medium rate experimental group, completed the total number of sounds in 15 timings. In the low rate experimental group (maintained at 40 sounds per minute), Subject #6 completed 23 timings during the experimental phase, while Subject #9 completed 25 timings. The data are displayed in Table 5.

Table 5

Experimental Phase Data

| Group and Subject | | Letter Sounds—Correct Per Minute
Incorrect Per Minute | | |

Final Phase

Upon completion of the experimental phase, an uncontrolled probe timing on saying letter sounds was administered to each subject. Subjects #1, #4, and #7 in the high rate experimental group said letter sounds at rates of 114, 115, and 91 per minute, respectively. In the medium rate experimental group, Subjects #2, #5, and #8 said letter sounds at 77, 71, and 83 per minute, respectively. Subject #5 had five errors. All other subjects had no errors. Subjects #3, #6, and #9 said letter sounds at uncontrolled rates of 63, 80, and 41 per minute, respectively. Subject #3 had two errors. An untimed trial on saying CVC trigrams was again administered to each subject. Percentage correct is listed in Table 6.

During the last portion of the final phase, 15 one-minute timings were completed on saying CVC trigrams. Three timings were administered daily. This portion of the study took five days to complete for each subject. The data are displayed in Table 6.

Analysis of Results

Several measures were used for analysis of the experimental results. The median correct scores of the first and last three CVC trigram timings of the final phase were used to determine a frequency multiplier. This ratio comparison of the two median frequencies is represented as the distance involved in moving from one frequency to

Table 6

Final Phase Data

Group and Subject	CVC-% (Correct)	CVC Timings (Correct/Incorrect) per minute																			
Group 80																					
Subject #1	99	53	39	53	54	57	57	58	61	55	74	69	73	73	70	69					
		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
Subject #4	93	42	45	58	60	62	65	65	68	73	72	72	70	72	73	70					
		8	5	3	4	3	7	8	8	7	7	8	6	7	6	6					
Subject #7	97	39	46	52	40	43	46	43	47	43	47	51	49	54	49	50					
		2	4	0	2	0	0	0	0	0	0	0	0	0	0	0					
Group 60																					
Subject #2	88	34	36	33	38	45	44	47	47	49	41	48	55	44	48	45					
		5	3	6	8	1	5	1	4	0	2	1	1	1	1	1					
Subject #5	83	16	12	19	18	27	23	29	33	35	34	30	29	31	29	36					
		10	11	7	6	7	11	4	4	2	1	8	5	3	6	4					
Subject #8	81	25	15	24	21	22	23	39	32	36	34	32	31	34	20	28					
		6	8	6	5	5	3	0	6	3	4	4	4	2	6	2					
Group 40																					
Subject #3	93	43	46	58	58	63	50	69	50	57	58	48	57	65	64	60					
		6	7	6	6	3	4	5	2	3	3	2	2	6	8	5					
Subject #6	91	21	34	36	38	35	32	37	47	45	38	41	38	31	37	35					
		9	3	1	2	3	3	4	7	5	2	1	1	2	2	2					
Subject #9	83	28	28	30	36	24	35	41	52	39	26	38	42	40	51	44					
		4	7	6	6	9	6	4	5	9	6	4	8	10	6	6					

another frequency, and is denoted numerically (Pennypacker, Koenig, & Lindsley, 1972). Gain scores were also determined from the median correct scores of the first and last three CVC trigram timings of the final phase. These two measures represent the growth during the final phase.

The celeration of all the CVC trigram timings of the final phase were determined for each subject. The quarter-intersect method, which yields a high degree of accuracy (Pennypacker et al., 1972) was used to determine the celerations.

In addition to the above measures, the median correct score of the CVC timings during the initial phase and the median correct score of the CVC timings during the final phase were used to determine a frequency multiplier for each subject. Gain scores were also calculated from the two median scores. These measures represent the growth from the initial phase before the experimental treatment to the end of the final phase.

An untimed test measuring percent correct and incorrect on CVC trigrams was completed during the initial phase and during the final phase for each subject. Gain scores were calculated from the correct percentage scores.

An uncontrolled probe on saying letter sounds was administered upon completion of the experimental phase. This determined if the subject's actual performance rate of saying sounds was consistent with the rate held constant by the controlled reader. The first timing of letter sounds during the initial phase was compared with this

uncontrolled probe timing by calculating a frequency multiplier and using a gain score.

Median Comparisons During Final Phase

The median of the first three CVC timings and the median of the last three CVC timings during the final phase, the gain scores and the frequency multipliers determined from these two medians, and the total gain scores are presented in Table 7. A visual display of the median comparisons in terms of frequency multipliers is provided in Figure 2. An analysis of the median scores on saying CVC trigrams indicates that the high rate experimental group gained more words than the medium or low rate groups as noted by a total gain of 58 words for the high rate group and 30 and 37 total gains for the medium and low groups, respectively.

Final Phase Celerations

The quarter-intersect method was used to determine celerations of the CVC trigram data of each subject during the final phase. As indicated in Appendix C, in the high rate experimental group, a celeration of x1.14 was noted for Subject #1, a x1.1 for Subject #4, and a x1.05 for Subject #7. In the medium rate experimental group, a celeration of x1.1 was noted for Subject #2, while x1.2 was noted for Subject #5, and a x1.18 for Subject #8. Celerations of x1., x1.03, and x1.15 were observed for Subjects #3, #6, and #9 respectively, all in the low rate experimental group. Celerations on academic behavior charts are provided in Appendix C with one week on the chart

Table 7

Median Comparisons During Final Phase

Group and Subject	Median 1st 3 CVC Timings Correct Per Minute	Median Last 3 CVC Timings Correct Per Minute	Gain	Frequency Multiplier
Group 80				
Subject #1	53	70	17	x1.32
Subject #4	45	72	27	x1.60
Subject #7	46	50	4	x1.09
			58 = total gain	
Group 60				
Subject #2	34	45	11	x1.32
Subject #5	16	31	15	x1.94
Subject #8	24	28	4	x1.17
			30 = total gain	
Group 40				
Subject #3	46	64	20	x1.39
Subject #6	34	35	1	x1.03
Subject #9	28	44	16	x1.57
			37 = total gain	

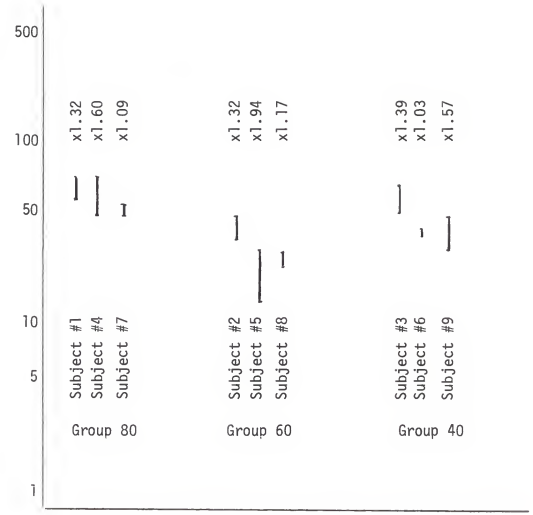

Figure 2

Frequency Multipliers for Median Comparisons
During Final Phase

representing one day's timings. A visual display of final phase celerations is provided in Figure 3 starting at the median of the first three timings of the final phase.

Median Comparisons of Initial and Final Phases

The median of the first two CVC timings during the initial phase and the median of the last three CVC timings during the final phase, the gain scores and frequency multipliers determined from these two medians, and the total gain scores are reported in Table 8. A visual display of the median comparisons of initial and final phases in terms of frequency multipliers is provided in Figure 4. An analysis of the gain in CVC words from the initial phase median to the last final phase median indicates that the high rate experimental group had the highest total gain of 107 words, while the low group had a total gain of 59 words, and the medium rate group had a total gain of 36 words.

Percentage Comparisons of Initial and Final Phases

An untimed test measuring percent correct and incorrect on saying CVC trigrams was completed during the initial phase and during the final phase for each subject. The total percent gain for the high rate experimental group was 29 points while the total gain for the medium group was 18 points, and the low group was 11 points. Percentage comparisons are provided in Table 9.

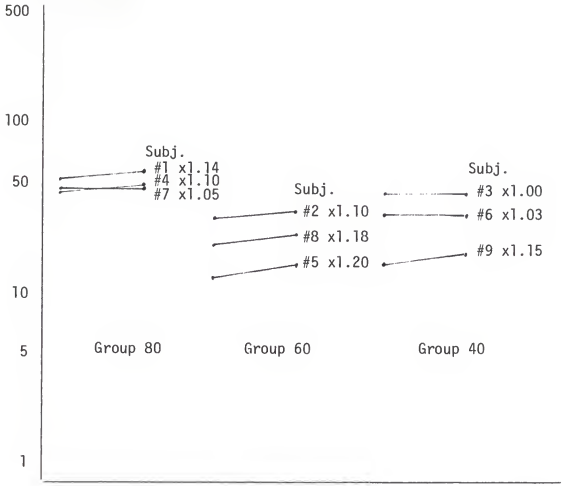

Figure 3

Celerations of CVC Trigram Timings
During Final Phase

Table 8

Median Comparisons of Initial and Final Phases

Group and Subject	Median of CVC Timings During Initial Phase Words Correct Per Minute	Median of Last 3 CVC Timings During Final Phase Words Correct Per Minute	Gain	Frequency Multiplier
Group 80				
Subject #1	31	70	39	x2.26
Subject #4	31	72	41	x2.32
Subject #7	23	50	27	x2.17
			107 = total gain	
Group 60				
Subject #2	21	45	24	x2.14
Subject #5	22	31	9	x1.41
Subject #8	25	28	3	x1.12
			36 = total gain	
Group 40				
Subject #3	28	64	36	x2.29
Subject #6	27	35	8	x1.30
Subject #9	29	44	15	x1.52
			59 = total gain	

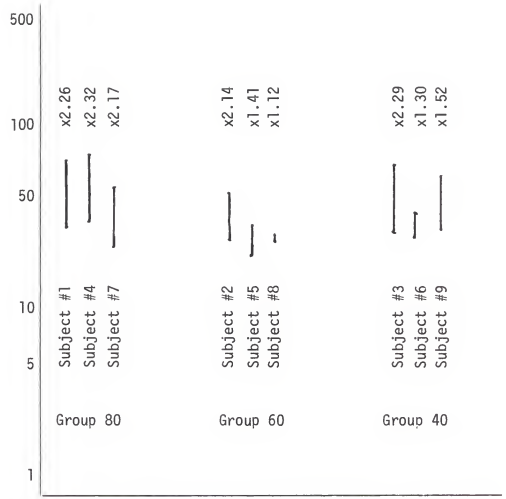

Figure 4

Frequency Multipliers for Median Comparisons
of Initial and Final Phases

Table 9

Percentage Comparisons

Group and Subject	Initial Phase % Correct	Final Phase % Correct	Gain
Group 80			
Subject #1	81	99	18
Subject #4	88	93	5
Subject #7	91	97	6
			29 = total gain
Group 60			
Subject #2	80	88	8
Subject #5	75	83	8
Subject #8	79	81	2
			18 = total gain
Group 40			
Subject #3	86	93	7
Subject #6	91	91	0
Subject #9	79	83	4
			11 = total gain

Initial Sound Timing and Uncontrolled Probe Comparisons

The first sound timing administered during the initial phase and the uncontrolled probe timing administered during the final phase were compared using gain scores and frequency multipliers. The total gain from the initial sound timing to the uncontrolled probe timing of the high rate experimental group was 171 sounds said correctly per minute. The medium group had a total gain of 115 sounds and the low group had a total gain of 94 sounds. The sound timing comparisons are provided in Table 10. A visual display of these comparisons in terms of frequency multipliers is presented in Figure 5.

Summary

Data were displayed for the initial phase, experimental phase, and final phase for each subject. The experimental results were analyzed in several ways. A ranking of the results is provided in Table 11. The median correct scores of the first and last three CVC trigram timings of the final phase were compared with gain scores and frequency multipliers. The high rate experimental group had the highest total gain of 58 words while the medium rate group had the lowest total gain of 30.

The median correct scores of the first two CVC timings during the initial phase and the median of the last three CVC timings during the final phase were compared with gain scores and frequency multipliers. The high rate experimental group had the highest total

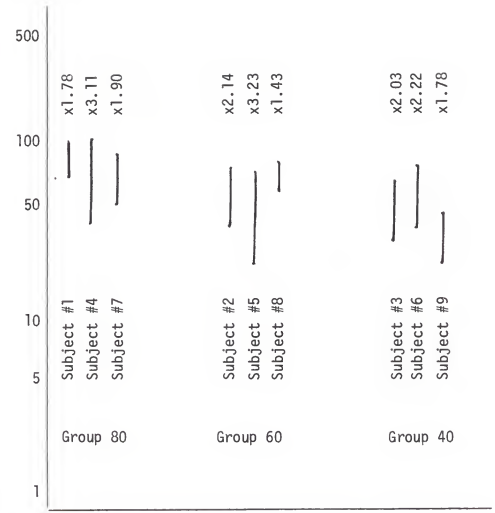

Figure 5

Frequency Multipliers for Initial Sound Timing
And Uncontrolled Probe Comparisons

Table 10

Initial Sound Timing and Uncontrolled Probe Comparisons

Group and Subject	1st Sound Timing Sounds Correct Per Minute During Initial Phase	Uncontrolled Probe—Sounds Correct Per Minute	Gain	Frequency Multiplier
Group 80				
Subject #1	64	114	50	x1.78
Subject #4	37	115	78	x3.11
Subject #7	48	91	43	x1.90
			171 = total gain	
Group 60				
Subject #2	36	77	41	x2.14
Subject #5	22	71	49	x3.23
Subject #8	58	83	25	x1.43
			115 = total gain	
Group 40				
Subject #3	31	63	32	x2.03
Subject #6	36	80	44	x2.22
Subject #9	23	41	18	x1.78
			94 = total gain	

Table 11

Rankings of Results

Method of Analysis	Ranking (1=high, 2=medium, 3=low)		
	Group 80	Group 60	Group 40
Median Comparisons During Final Phase Total Gain Score	1	3	2
Median Comparisons During Initial and Final Phases Total Gain Score	1	3	2
Percentage Comparisons Total Gain Score	1	2	3
Sound Timing Comparisons Total Gain Score	1	2	3

gain of 107 words, while the medium group had the lowest total gain of 36 words. Percentage correct and incorrect on CVC trigrams was measured during the initial and final phases. The highest total gain was 29 points in the high rate experimental group. The lowest total gain was 11 points in the low rate experimental group.

The first sound timing during the initial phase and uncontrolled sound timing during the final phase were compared using gain scores and frequency multipliers. The highest total gain was 171 sounds in the high rate experimental group, while the lowest total gain was 94 sounds in the low rate experimental group.

Thus, the high rate experimental group had the highest total gains in all of the measures discussed. Results were equally divided between the medium and low rate experimental groups as to which performed the next highest and the lowest on the four gain measures.

Similar Subject Comparisons

To further analyze the data, three subjects were selected, one from each experimental group, who were most similar on the initial phase sound timing. Final phase celerations and all comparisons previously discussed are presented with these subjects to determine if a relationship exists between rate of saying letter sounds and subsequent performance on saying CVC trigrams. Similar subject comparisons are provided in Table 12. A visual display of final phase median comparisons, initial to final phase median comparisons, and sound timing comparisons in terms of frequency multipliers for each subject is presented in Figure 6. The high rate experimental subject (Subject #4) had the highest gain score and frequency multiplier in the final phase comparisons, initial to final phase median comparisons, and the initial sound timing and uncontrolled probe comparisons.

Table 12

Similar Subject Comparisons

Group and Subject	Median of initial phase CVC timings correct per minute	Initial Phase Sound Timing Correct per minute	Final Phase Median Comparisons Gain Score	Final Phase Median Comparisons Freq. Mult.	Final Phase Celeration	Initial to Final Phase Median Comparisons Gain Score	Initial to Final Phase Median Comparisons Freq. Mult.	Percentage Comparisons Gain Score	Initial Sound Timing Uncontrolled Probe Comparisons Gain Score	Initial Sound Timing Uncontrolled Probe Comparisons Freq. Mult.
Group 80 Subject #4	31	37	27	1.60	1.1	41	2.32	5	78	3.11
Group 60 Subject #2	21	36	11	1.32	1.1	24	2.14	8	41	2.14
Group 40 Subject #6	27	36	1	1.03	1.03	8	1.30	0	44	2.22

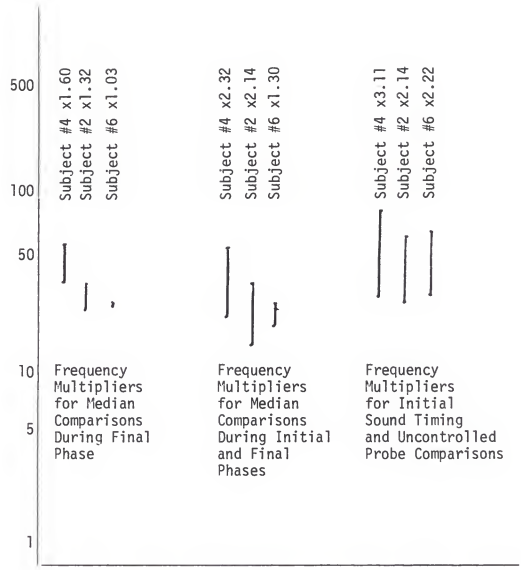

Figure 6

Similar Subject Comparisons

CHAPTER V

DISCUSSION

There has been a great deal of interest in establishing rate criteria for various academic skills. If optimum proficiency aims were established for academic skills, perhaps no more time than necessary would be spent teaching a particular skill. The performance level of a particular skill is thought to make a critical difference on progress at the next level (Haughton, 1972). This study investigated the relationship between rate of saying letter sounds and subsequent performance on saying CVC trigrams when the amount of practice was controlled.

This chapter presents a summary and interpretation of the findings. Problems and limitations are discussed. Practical implications and suggestions for future research complete the discussion chapter.

Interpretation of the Findings

The findings of this study are interpreted relative to the experimental question: Is there a relationship between rate of saying letter sounds and subsequent performance on saying CVC trigrams when

amount of practice is controlled? Interpretation involves the following measures of analysis: (a) median comparisons during the final phase; (b) final phase celerations; (c) median comparisons of initial and final phases; (d) percentage comparisons; (e) initial sound timing and uncontrolled probe comparisons; and (f) similar subject comparisons.

The findings are interpreted across the three groups using gain scores. Frequency multipliers and celerations are methods of looking at individual cases and provide visual inspection of the data.

Median Comparisons During Final Phase

The last 15 timings during the final phase represent subsequent performance on saying CVC trigrams, and demonstrate the relationship of different rates of experimental treatment, or saying letter sounds, to the subsequent skill of saying CVC trigrams. An examination of the data presented in Table 6 indicates that subjects in Group 80, the high rate experimental group, started the final phase with generally higher scores than subjects in the other experimental groups. These data suggest that training at a high rate during the experimental phase had an immediate transfer to a higher rate on the subsequent task of saying CVC trigrams.

The median correct scores of the first and last three CVC trigram timings of the final phase were used to determine individual gain scores and a total gain score for each group. An analysis of the data from Table 7 indicates that the high rate experimental group had

the highest total gain of CVC trigrams, a gain of 58 words, while the medium rate experimental group had the lowest total gain of 30 words. A relationship between a high rate of saying letter sounds and subsequent performance on saying CVC trigrams is demonstrated with this measure.

Frequency multipliers, displayed in Figure 2, represent ratio comparisons of the two median correct scores. Because subjects in the medium rate experimental group generally started the final phase with lower rates of saying CVC trigrams, there was more proportional behavior change in data obtained from these subjects even though there were fewer words gained. Subject #5, for example, increased words said from a median of 16 to a median of 31, a gain of 15 words, almost doubling the number of words said from the beginning to the end of the final phase. Subject #1, however, increased words said by 17 starting at a median of 53 words said correctly and ending at a median of 70 words said correctly. Subject #5 had a frequency multiplier of x1.94 while Subject #1 had a frequency multiplier of x1.32. This illustrates the difference in proportional growth between these two subjects.

It is, therefore, important to consider the starting and ending data points when analyzing the data. Generally, subjects in Group 80 had higher median scores for the first three timings of the final phase. As a result, it was more difficult for the subjects in this group to increase the number of CVC words said during subsequent sessions. This suggests that conclusions drawn from the frequency

multiplier data must be viewed cautiously in that other variables affect interpretation.

Final Phase Celerations

Celerations of the 15 CVC trigram timings during the final phase were determined for each subject for words said correctly. These celerations are provided in Appendix C and Figure 3. An analysis of the data in Table 6 indicates that the subjects in the medium rate experimental group started the final phase with lower correct scores than subjects in the other two experimental groups. Again, there was more proportional change in subjects in the medium rate group. This suggests that it may have been easier for these subjects to increase the number of CVC words said due to their initial lower starting point. This might account for the generally higher celerations of the medium rate group.

Median Comparisons of Initial and Final Phases

The median correct score of the CVC timings during the initial phase and the median correct score of the CVC timings during the final phase were used to determine a gain score and a frequency multiplier for each subject. These measures represent growth from the initial phase before experimental treatment, to the end of the final phase. The high rate experimental group had the highest total gain score, while the low rate experimental group had the second highest total gain score. A relationship between a high rate of saying letter sounds and subsequent performance on saying CVC trigrams is demonstrated with this gain measure.

Percentage Comparisons

Gain scores were calculated from correct percentage scores completed during the initial and final phases. A clear relationship between all examined rates of saying letter sounds and subsequent performance on saying CVC trigrams exists in this analysis. This relationship is evidenced in that the high rate experimental group had the highest total gain, the medium rate experimental group had the next highest total gain, while the low rate experimental group had the lowest total gain.

Initial Sound Timing and Uncontrolled Probe Comparisons

The first sound timing administered during the initial phase and the uncontrolled probe timing administered during the final phase were used to determine a gain score and frequency multiplier for each subject. This measure offered supplementary information indirectly related to the experimental question. It is interesting to note that all subjects performed at a higher rate in the uncontrolled probe than at the rate maintained during the experimental phase. This demonstrates that, even though rates of performance are fixed at a particular rate, when given an opportunity for unlimited performance, all subjects performed at higher rates. Subjects in the high rate experimental group had a total gain of 171 sounds, with two subjects saying sounds at rates of 114 and 115 per minute during the uncontrolled probe. Subjects in the medium rate experimental group had a total gain of 115 sounds, while subjects in the low rate experimental group had a total gain of 94 sounds. These data suggest that training

at a high rate on the task of saying letter sounds transfers to higher rates on the same task when given an unlimited opportunity.

Similar Subject Comparisons

An examination of the data displayed in Table 12 and Figure 6 indicates that in six of eight measures, the high rate experimental subject had the highest gain score or frequency multiplier, and in six of eight measures, the low rate experimental subject had the lowest gain score, frequency multiplier, or final phase celeration. Data from final phase median comparisons and from initial to final phase median comparisons suggest that training at a high rate during the experimental phase had an immediate transfer to a higher rate on saying CVC trigrams. Data from sound timing comparisons suggest that training at a high rate during the experimental phase transferred to a higher rate of saying sounds when the subject was given unlimited opportunity. Because the data are so similar in final phase celerations and percentage comparisons, the relationship between rate of saying sounds and subsequent performance on saying CVC trigrams is not clear using these measures.

Summary

The high rate experimental group had the highest total gains in all measures discussed. This group had the highest total gain of the final phase median comparisons, the highest total gain of the initial to final phase median comparisons, the highest total gain of the percentage comparisons, and the highest total gain of the sound

timing comparisons (indirectly related to the experimental question). Results were equally mixed concerning the groups which performed the next highest and the lowest on the measures.

An analysis of the data in Table 11 clearly demonstrates a relationship between a high rate of saying letter sounds and subsequent performance on saying CVC trigrams when amount of practice is controlled. An examination of the data in Table 12 indicates that this relationship also holds true for individual subject comparisons. Subjects in the high rate experimental group performed better on the subsequent task than subjects in the medium or low rate experimental groups. As Haughton (1972) suggests, there seems to be an important relationship between certain frequencies and that skill's growth, and to growth in a related skill. This relationship exists even when the amount of practice is controlled.

This study suggests that the high rate of 80 sounds per minute was related to improved performance on the subsequent task of saying CVC trigrams, but does not speak to an optimum or critical rate for this specific prerequisite skill. To determine the optimum proficiency level of a particular skill, effects of training to various standards on the subsequent acquisition of more complex skills need to be examined, as VanHouten (1979) suggests.

Problems and Limitations of the Study

There were two problems that appeared during the course of this investigation. The first problem involves matching of subjects and the second problem involves establishing rate criteria for each of the three experimental groups.

All subjects were matched on the task of saying CVC trigrams during the initial phase. There was a range of no greater than 10 words correct per minute of saying CVC trigrams between the nine subjects. The median rate ranged from 21 words correct per minute for Subject #2, to 31 words correct per minute for Subjects #1 and #4. Each subject was also administered a one-minute timing on saying letter sounds. However, the nine subjects were not matched on this task, and there was a range of 22 to 64 sounds said correctly per minute. This indicates that past experience in working with letter sounds may not have been similar with each subject. While it is not felt that this problem presents a serious threat to the findings of the study, the reader should be aware of this information.

Rate criteria for the high, medium, and low rate experimental groups was established based on rate data collected by various researchers as provided in Table 2. The mode and median rate for saying isolated sounds was 80 sounds per minute. Of eight sources, only one researcher suggested saying sounds at a rate higher than 80 sounds per minute. Perhaps the relationship between rate of saying sounds and subsequent performance of saying CVC trigrams might have been more clearly demonstrated had a higher rate been established for the high rate experimental group, and a greater rate range between the high, medium, and low rate experimental groups.

An additional limitation concerns the time of year in which the study was completed. Student performance may have been influenced by extra activities such as field trips and other school-wide events that occurred near the end of the school year.

Implications and Suggestions for Future Research

Different guidelines are available to teachers to determine when to advance children from one skill to the next. Often rate criteria are used to determine advancement. Disagreement exists, however, concerning what rates constitute proficiency in specific skills. Certain frequencies are thought to be important in learning specific skills and subsequent learning of a related skill. This study investigated the relationship between rate of saying letter sounds and subsequent performance on saying CVC trigrams.

The findings in this study have practical implications to those involved in research or applied work. A relationship appears to exist between a high rate of saying letter sounds and subsequent performance on saying CVC trigrams when the amount of practice is controlled. The level of performance on a skill does make a difference on progress at the next level. Specifying certain aims could make a critical difference in competence and independence in a specific skill.

More research is needed in this area before the relationship of rate and subsequent performance can be fully understood. Suggestions for future research are as follows:

1. The study should be replicated using different rate criteria for saying letter sounds. A higher rate should be set for the high rate experimental group with a wider rate range between groups.

2. Subjects should be matched on saying CVC trigrams and letter sounds when replicating this study.

3. The relationship of other academic skills and subsequent performance on related academic skills is a needed area of research.

4. A need exists to determine what the optimum aims are for specific skills. It is important to establish when a child has mastered a skill sufficient for adequate performance in subsequent related skills. When optimum aims are established, no more time than necessary will be spent teaching a particular skill as the child will not accelerate beyond the proficiency level.

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APPENDIX A

PROBE SHEETS

Probe Sheet #1

b	z	p	w	t	a	f	h	s	k
c	a	g	d	n	j	l	v	a	m
y	r	s	k	a	h	f	w	t	p
a	z	b	r	y	m	a	v	l	j
d	n	a	g	c	b	s	r	a	c
g	z	k	y	p	a	n	c	w	h
m	d	a	f	v	t	j	l	a	t
h	j	m	p	n	a	f	v	d	w

Alternate Probe Sheet #1

d n a g c b s r a c

g z k y p a n c w h

m d a f v t j l a t

h j m p n a f v d w

b z p w t a f h s k

c a g d n j l v a m

y r s k a h f w t p

a z b r y m a v l j

Probe Sheet #2

sat	ran	mad	cap	wag	ham	cab	fat	tan	pad
bag	lap	yam	hat	van	tap	cat	had	jam	tab
zap	rat	fan	tag	sad	map	can	pat	man	sag
bad	ram	mat	rag	jab	bat	sap	tan	pad	fat
cab	ham	wag	cap	mad	ran	sat	tab	jam	had
cat	tap	van	hat	yam	lap	bag	sag	man	pat
can	map	sad	tag	fan	rat	zap	fat	pad	tan
sap	bat	jab	rag	mat	ram	bad	had	jam	tab
sat	ran	mad	cap	wag	ham	cab	pat	man	sag
bag	lap	yam	hat	van	tap	cat	tan	pad	fat

APPENDIX B

RAW DATA SHEETS AND ACADEMIC BEHAVIOR CHART

Say Letter Sounds

b	d
z	n
p	a
w	g
t	c
a	b
f	s
h	r
s	a
k	c
c	g
a	z
g	k
d	y
n	p
j	a
l	n
v	c
a	w
m	h
y	m
r	d
s	a
k	f
a	v
h	t
f	j
w	l
t	a
p	t
a	h
z	j
b	m
r	p
y	n
m	a
a	f
v	v
l	d
j	w

Subject # _____

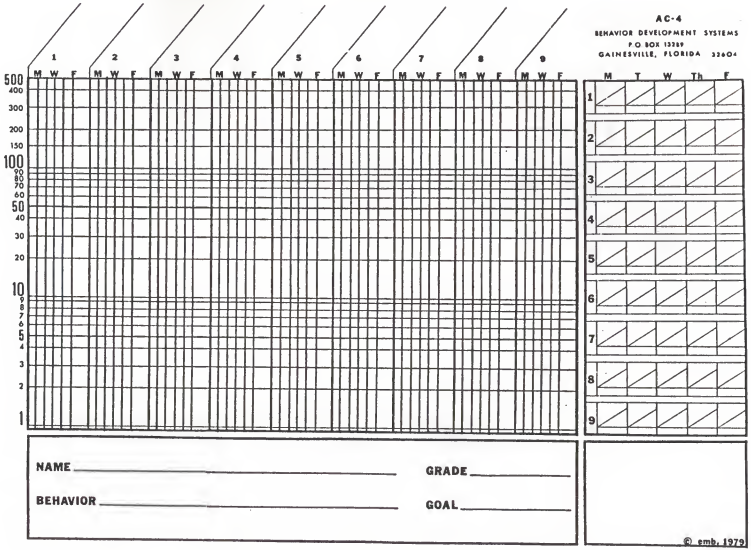
Date _____

Say CVC Trigrams

sat								cat						
ran								tap						
mad								van						
cap								hat						
wag								yam						
ham								lap						
cab								bag						
fat								sag						
tan								man						
pad								pat						
bag								can						
lap								map						
yam								sad						
hat								tag						
van								fan						
tap								rat						
cat								zap						
had								fat						
jam								pad						
tab								tan						
zap								sap						
rat								bat						
fan								jab						
tag								rag						
sad								mat						
map								ram						
can								bad						
pat								had						
man								jam						
sag								tab						
bad								sat						
ram								ran						
mat								mad						
rag								cap						
jab								wag						
bat								ham						
sap								cab						
tan								pat						
pad								man						
fat								sag						
cab								bag						
ham								lap						
wag								yam						
cap								hat						
mad								van						
ran								tap						
sat								cat						
tab								tan						
jam								pad						
had								fat						

Subject #_____ Pretest or Posttest?

Academic Behavior Chart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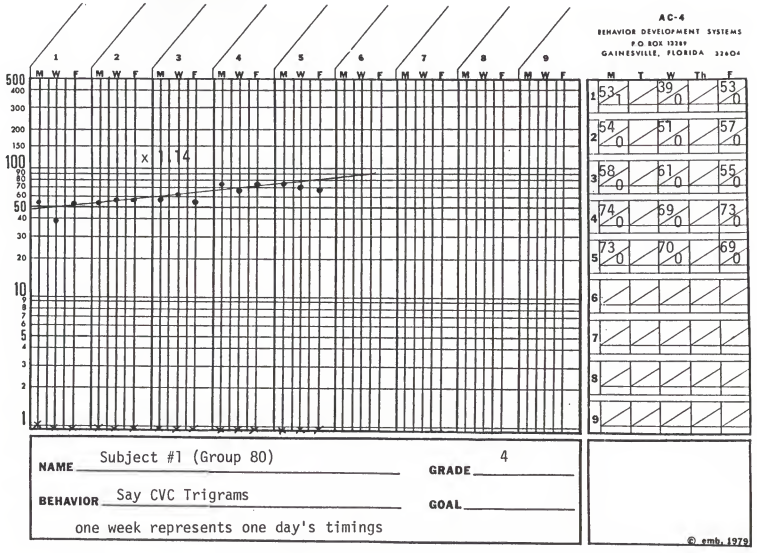
M T W Th F
1 2 3 4 5 6 7 8 9
NAME
GRADE
BEHAVIOR
GOAL
© emb, 1979

APPENDIX C

CELERATIONS ON ACADEMIC BEHAVIOR CHARTS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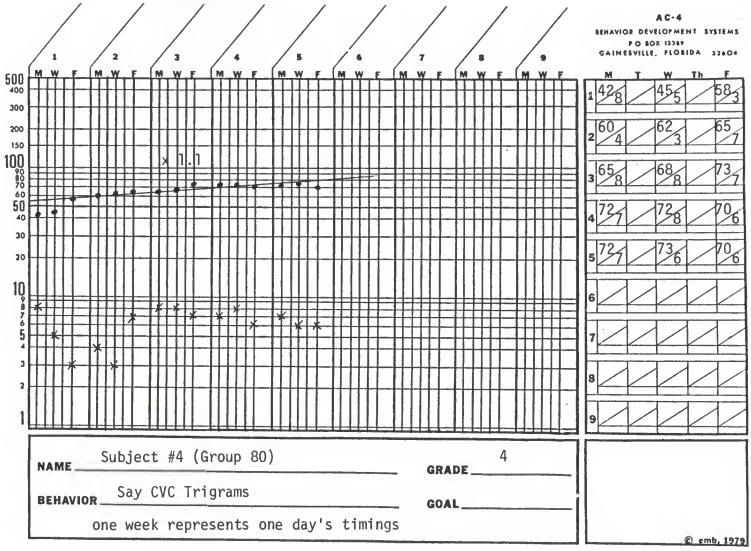
x 114
M T W Th F
1 53 1 39 0 53 0
2 54 0 51 0 57 0
3 58 0 61 0 55 0
4 74 0 59 0 73 0
5 73 0 70 0 69 0
6
7
8
9
NAME Subject #1 (Group 80)
GRADE 4
BEHAVIOR Say CVC Trigrams
GOAL
one week represents one day's timings
© emb, 1979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x 11.1
M T W Th F
1 42 8 45 5 58 3
2 60 4 62 3 65 7
3 65 8 68 8 73 7
4 72 7 72 8 70 6
5 72 7 73 6 70 6
6
7
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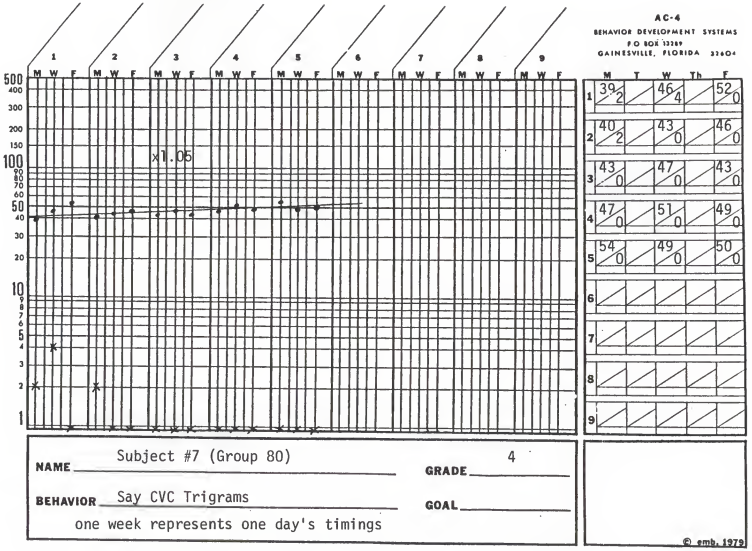
9
NAME Subject #4 (Group 80)
GRADE 4
BEHAVIOR Say CVC Trigrams
GOAL
one week represents one day's timings
© emb, 1979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x1.05
M T W Th F
1 39/2 46/4 52/0
2 40/2 43/0 46/0
3 43/0 47/0 43/0
4 47/0 51/0 49/0
5 54/0 49/0 50/0
6
7
8
9
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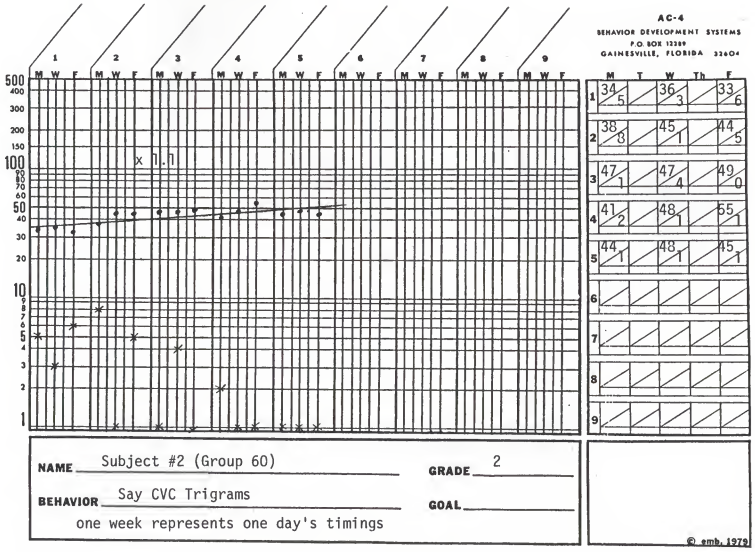
GRADE 4
BEHAVIOR Say CVC Trigrams
GOAL
one week represents one day's timings
© emb, 1979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x 11.1
M T W Th F
1 34/5 36/3 33/6
2 38/3 45/1 44/5
3 47/1 47/4 49/0
4 41/2 48/1 55/1
5 44/1 48/1 45/1
6
7
8
9
NAME Subject #2 (Group 60)
GRADE 2
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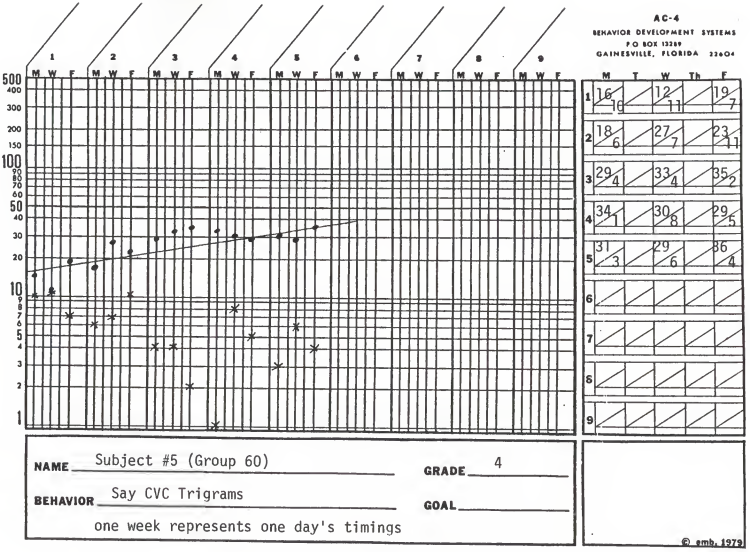
GOAL
one week represents one day's timings
© emb, 1979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2 18 6 27 7 23 11
3 29 4 33 4 35 2
4 34 1 30 8 29 5
5 31 3 29 6 36 4
6
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8
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GRADE 4
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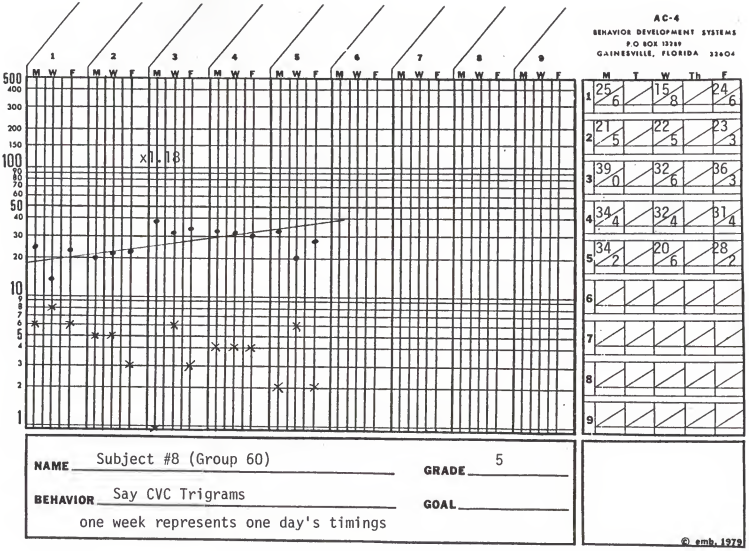
GOAL
one week represents one day's timings
© emb, 1979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2 21/5 22/5 23/3
3 39/0 32/6 36/3
4 34/4 32/4 31/4
5 34/2 20/6 28/2
6
7
8
9
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GRADE 5
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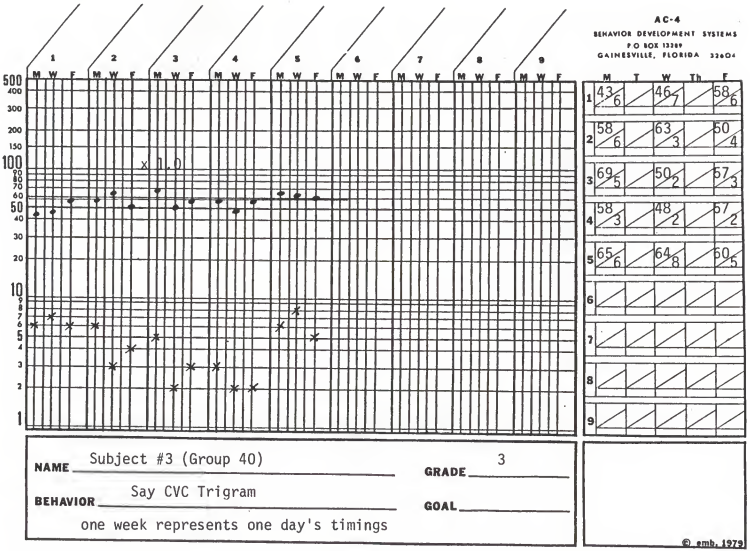
GOAL
one week represents one day's timings
© emb, 1979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x 1.0
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2 58/6 63/3 50/4
3 69/5 50/2 57/3
4 58/3 48/2 67/2
5 65/6 64/8 50/5
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GRADE 3
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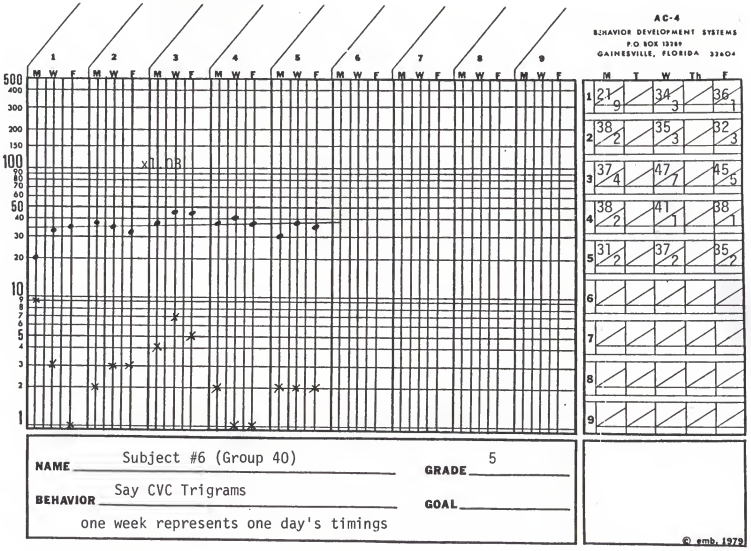
GOAL
one week represents one day's timings
© emb. 1979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2 38/2 35/3 32/3
3 37/4 47/7 45/5
4 38/2 41/1 38/1
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GRADE 5
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GOAL
one week represents one day's timings
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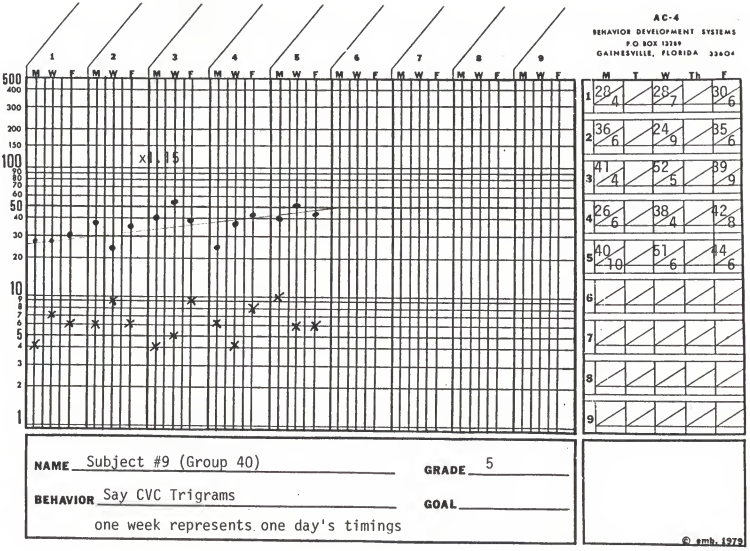
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500 400 300 200 150 100 90 80 70 60 50 40 30 20 10 9 8 7 6 5 4 3 2 1
x1.15
M T W Th F
1 28/4 28/7 30/6
2 36/6 24/9 35/6
3 41/4 52/5 89/9
4 26/6 38/4 42/8
5 40/10 51/6 44/6
6
7
8
9
NAME Subject #9 (Group 40)
GRADE 5
BEHAVIOR Say CVC Trigrams
GOAL
one week represents one day's timings
© emb, 1979

BIOGRAPHICAL SKETCH

Susan S. Evans was born December 26, 1948, in Philadelphia, Pennsylvania. She was graduated from Lycoming College in Williamsport, Pennsylvania, in 1970 with a Bachelor of Arts degree in psychology. After graduation she taught sixth grade for three years in New Jersey.

In 1974, Susan received her Master of Education degree in special education from the University of Florida. Her main emphasis was learning disabilities. From 1974 to 1980, she was employed by the Alachua County School System as a teacher of varying exceptionalities.

Susan attended the University of Florida from 1977 to August of 1981 as a doctoral student in special education. Her major emphasis was learning disabilities with minors in emotional handicaps and research.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Cecil D. Mercer, Chairman
Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Robert F. Algozzine
Associate Professor of Special Education

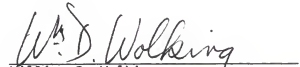
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Suzanne Krogh
Assistant Professor of General Teacher Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

William R. Reid
Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.



William D. Wolking
Professor of Special Education

This dissertation was submitted to the Graduate Faculty of the Department of Special Education in the College of Education and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August, 1981

Dean, Graduate School